

**THE METEORITIC WIDMANSTÄTTEN STRUCTURE: A MODERN METALLURGICAL REEVALUATION.** P. Z. Budka<sup>1</sup> and J.R.M. Viertl<sup>2</sup>, <sup>1</sup>(2135 Morrow Ave., Schenectady, NY 12309 e-mail: 75302.1764@compuserve.com), <sup>2</sup>(1403 Clifton Park Rd., Schenectady, NY 12309).

The model of the metallic meteorite Widmanstätten Structure formed as the core of a meteorite parent body under kilobars of pressure, surrounded by kilometers of silicate materials and cooling over millions of years, represents metallurgical understanding may require an adjustment to long-held ideas of meteoritic Widmanstätten structure formation. (Budka, Viertl and Thamboo 1996). Given the importance of meteoritic Widmanstätten structure formation to meteoritics, it is reasonable to reconsider its formation today, starting with the structures visible to the naked eye.

Osmond and Cartaud set the themes in 1904: equilibrium and slow cooling rates are associated with meteorites; laboratory experiments are associated with metastability and rapid cooling rates; there is no other fundamental difference between alloys synthesized in the laboratory and nickel-iron meteorites.

The concept of Ni-Fe cores under kilobars of pressure are founded in Uhlig's estimated phase diagram for iron-nickel alloys under high pressure (Uhlig 1954 and 1955). Uhlig's calculations, in turn, rely on the assumptions of Osmond and Cartaud. The M-profile analysis across the kamacite-taenite interface is the foundation for calculations of the cooling rates of nickel-iron meteorites; this approach is also based on the work of Osmond and Cartaud. Taken together, these works have been the metallurgical foundations for models of meteorite parent body formation.

The task in viewing the meteoritic Widmanstätten structure with "new eyes" is first, to provide alternate metallurgical interpretations consistent with the macro/microstructural evidence and second, to recognize which calculations and theories are based on Osmond and Cartaud's assumptions. For example, an "M-profile" is generated by microprobe analysis across the kamacite-taenite interface. The same M-profile is consistent with the solidification model in which kamacite is produced directly from a liquid (delta ferrite) and taenite is produced in a peritectic reaction (Budka, Viertl and Thamboo 1996). The M-profile does not clearly distinguish a solid state phase transformation

from a solidification process. Therefore, no unique thermal history should be deduced for a body-centered cubic low nickel-iron crystal structure (Thoma and Perepezko 1992).

Thus, the concept that the meteoritic Widmanstätten structure is the product of a solid state phase transformation over millions of years requires re-examination. An alternate model, consistent with modern metallurgical understanding, is that the meteoritic Widmanstätten structure was produced directly from a melt, logically under microgravity conditions, in a relatively short time frame.

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## References

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